



The photosensitive detector used to detect the image light focused thereon by the optical system may be a charge-coupled device (CCD), although other devices may be used. A typical CCD may comprise an array of individual cells or "pixels," each of which collects or builds-up an electrical charge in response to exposure of certain wavelengths of light energy. Since the quantity of the accumulated electrical charge in any given cell or pixel is related to the intensity and duration of the light exposure, a CCD may be used to detect light and dark spots on an image focused thereon.

Flatbed scanners and various components thereof are disclosed in U.S. Patent No. 4,926,041 for OPTICAL SCANNER to David Wayne Boyd; U.S. Patent No. 4,709,144 for BEAM SPLITTER AND PHOTSENSOR to Kent J. Vincent; U.S. Patent No. 4,870,268 for COLOR COMBINER AND SEPARATOR AND IMPLEMENTATIONS to Kent J. Vincent and Hans D. Neuman; U.S. Patent No. 5,038,028 for OPTICAL SCANNER APERTURE AND LIGHT SOURCE ASSEMBLY to Boyd, *et al.*; and U.S. Patent No. 5,227,620 for APPARATUS FOR ASSEMBLING COMPONENTS OF COLOR OPTICAL SCANNERS to Elder, *et al.*, which are assigned to the common assignee of the present invention and incorporated herein by reference for all that is disclosed therein.

While flatbed scanners are well known and are being used, they tend to have a rather large "footprint." As a result, flatbed scanners occupy a substantial amount of space wherever they are placed (*e.g.*, a desktop or a tabletop). An exemplary prior art desktop arrangement is illustrated in FIG. 1. As illustrated, a significant portion of the surface area of a desktop 10 may be consumed by a number of items associated in a common computing configuration. For example, the desktop 10 may be outfitted with a personal computer 12, a monitor 14, a printer 15, left and right channel stereo speakers 13a, 13b, a keyboard 16, and a mouse 18. A flatbed scanner 17, mouse pad 19, telephone 20, and an external modem device 30 may further clutter the desktop 10. It is easy to see that the flatbed scanner 17 consumes a significant portion of the area on the desktop 10. With the exception of today's popular large cathode ray tube (CRT) display monitors and some large printers (*e.g.*, the printer 15), the flatbed scanner 17 consumes the greatest area on the surface of the desktop 10.

Computer and computer peripheral device manufacturers have used several approaches to address the problem of a crowded desktop 10. These approaches have included various stacking schemes, such as stacking the monitor 14 or printer 15 on top of the computer 12, combining the keyboard 16 with the mouse 18 to form an integral input unit, or making the computer 12 and other peripherals narrower and taller, such as in the form of a computer tower 12, or a flat monitor 14. One such stacking arrangement is disclosed in U.S. Patent No. 5,822,080 to Chavez, assigned to the common assignee of the present invention and incorporated herein by reference, which discloses combining the lid of a flatbed scanner with a keyboard and a mouse. Scanner manufacturers have responded to the problem of a crowded desktop 10 by decreasing the size of the scanner 17. For example, sheet feeding scanners and hand-held scanners have been introduced. However, these scanning devices do not offer the flexibility of a flatbed scanner. Both sheet feed scanners and hand-held scanners are not capable of scanning bound documents, books, or three-dimensional objects. In addition, sheet feed and hand-held scanners do not provide preview scanning. Flatbed scanners are capable of performing these and other tasks. This leaves scanner users with the choice of trading desktop space for scanner functionality and flexibility. Thus, it would be desirable to have a flatbed scanner with the flexibility and functionality of current flatbed scanners while simultaneously reducing desktop space requirements.

### **SUMMARY OF THE INVENTION**

In response to these and other shortcomings of the prior art, a space-saving scanner assembly is disclosed. Briefly described, the space-saving scanner assembly can be constructed with a housing having a substantially vertical source-contact surface with a channel extending therefrom and a flap. The flap is coupled to the source-contact surface and has a source-backing surface substantially parallel to the source-contact surface of the housing and arranged such that the source-contact surface, the source-backing surface, and the channel form an opening for receiving an edge of a source document to be scanned.

A method for operating a space-saving scanner is also presented. The method

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### **BRIEF DESCRIPTION OF THE DRAWINGS**

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FIGs. 8A and 8B are schematic diagrams of the underside of the space-saving scanner assembly flap of FIG. 6.

FIG. 9 is a cross-sectional top view of an exemplary embodiment of the space-saving scanner assembly of FIG. 2 having a hinged flap.

5        FIG. 10 is a schematic diagram of the space-saving scanner assembly of FIG. 2, highlighting an alternative for closely arranging the underside of the flap with the platen.

### **DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

Having summarized various aspects of the space-saving scanner assembly, the  
10 space-saving scanner assembly will now be described in detail with reference to the drawings. While the invention will be described in connection with these drawings, there is no intent to limit it to the embodiment or embodiments disclosed therein. On the contrary, the intent is to cover all alternatives, modifications and equivalents included within the spirit and scope of the invention as defined by the appended  
15 claims. Turning now to the drawings, wherein like reference numerals designate corresponding parts throughout the drawings, reference is made to FIG. 2, which illustrates a schematic of an exemplary operational environment suited for a space-saving scanner assembly 100. In this regard, an exemplary operational environment may comprise a variation of the desktop 10 introduced with regard to FIG. 1.

20        As illustrated in FIG. 2, a modified desktop 11 may comprise a personal computer 12, a monitor 14, a printer 15, and a space-saving scanner assembly 100. As illustrated in the schematic diagram of FIG. 2, the space-saving scanner assembly 100 may be configured with an on/off switch 110, a control interface 120, as well as, various connectors for permitting input and output signals to be sent and received by  
25 the various devices on a front panel. In a preferred embodiment, the space-saving scanner assembly 100 is configured with a parallel input port connector 130, a parallel output port connector 140, a universal serial bus (USB) port 150, as well as, a direct current (DC) power receptacle 160. It will be appreciated by those skilled in the art that the parallel input and output port connectors 130, 140 and the USB port 150 may  
30 be configured with suitable interfaces for transferring operational commands to the space-saving scanner assembly 100 and scanned image data from the space-saving

scanner assembly 100. These and other suitable interfaces for transferring commands and data are well known and understood in the art and need not be disclosed herein to appreciate the space-saving scanner assembly 100.

As shown in FIG. 2, DC power may be supplied to the space-saving scanner  
5 assembly 100, via a power supply assembly comprising a transformer 111, an AC power plug 112, and a DC power jack 114. As is known, the power supply assembly may be configured to convert alternating current (AC) power from a wall receptacle to an appropriate DC voltage for providing the necessary power required to drive the various electrical components of the space-saving scanner assembly 100.

10 As illustrated in FIG. 2, the space-saving scanner assembly 100 supports a variety of command and data interface configurations. For example, the space-saving scanner assembly 100 may support a USB interface via the USB port 150, a USB cable 106, and a USB port in communication with the personal computer 12 (not shown). It will be appreciated that the USB port associated with the computer 12 may  
15 be used to connect numerous peripheral devices (*e.g.*, the space-saving scanner assembly 100, as well as, a host of other peripheral devices such as mice, modems, and keyboards). Importantly, the USB port supports Plug-and-Play installation and hot or powered plugging.

In addition, the space-saving scanner assembly 100 may be configured to  
20 support a parallel communications interface via the parallel input connector 130, a parallel communications cable 104. Furthermore, the space-saving scanner assembly 100 may be configured to interface with the printer 15 via the parallel output connector 140 and a printer interface cable 102. As is known, the combination of the parallel communications cable 104, the parallel input and output connectors 130, 140  
25 respectively, and the printer interface cable 102 may form an external parallel communications bus, capable of transmitting printer commands from the personal computer 12 through the aforementioned devices on to either the space-saving scanner assembly 100 or the printer 15 as desired.

It will be appreciated that the parallel port interface associated with the  
30 personal computer 12 preferably uses a 25-pin connector for connecting printers, computers, and other devices such as the space-saving scanner assembly 100 that

require a relatively high bandwidth. A newer type of parallel port may also be supported by the space-saving scanner assembly 100. Both an enhanced parallel port (EPP) or an extended Capabilities Port (ECP) may be supported over the same parallel input and output connectors 130, 140. Both of these next generation parallel ports support bi-directional communication and high data transfer rates. It will be further appreciated that the space-saving scanner assembly 100 may be configured with a small computer system interface (SCSI) for transferring data and commands to the printer 15 and the personal computer 12. Regardless of the data transfer format(s) selected to operate the space-saving scanner assembly 100, the parallel input and output connectors 130, 140 may be implemented with commercially available connectors such as a D-Sub connector, a Half-Pitch SCSI connector, a Full-Pitch SCSI connector, and other like connectors. The communications port, the connector type, and the number of conductors represent design choices that add to the flexibility of the space-saving scanner assembly 100.

The inputs and outputs of the space-saving scanner assembly 100 having been generally introduced and described in FIG. 2, reference is now directed to FIG. 3, which, presents a cross-sectional top view of an exemplary embodiment of the space-saving scanner assembly of FIG. 2. As illustrated in FIG. 3, the space-saving scanner assembly 100 may include a housing 300 and a flap 310. The housing 300 may be configured to contain an optical scanning means moveable along a guide rod, a transmission means for driving the optical scanning means, a transmission controller means, a first cable for signal transmissions and power distribution between the optical scanning means and the personal computer 12 (see FIG. 2), a second cable for control and power signal distribution between the transmissions means, and the transmission controller means. The housing 300 may also be associated with a transparent scanning plate or platen 305, a source-support channel 330, one or more threaded recesses 315, and a plurality of flap support posts 340.

The optical scanning means may be a charge-coupled device (CCD) scanning means known in the art (including a light source, a controller, and a CCD member, not shown in the figure), or a complementary metal oxide semiconductor (CMOS) scanning means, or a CIS scanning means (including a light source, a controller, and a

CIS contact type scanning member, not shown in the figure). The transmission means may be a motor in cooperation with one or more rollers or gears. As is known, the transmission means may be driven by a controller, which may be in communication with a scanning means controller, with both controllers in further communication with the personal computer 12. The motor may be a servo-motor, a DC motor, or a step motor, *etc.* The rollers may be a set of pulleys and or gears configured to receive a belt or a cog belt. The transmission means may also be constructed using one or more gears with a threaded rod as is known in the art.

The optical scanning means controller and the transmission means controller may together form a composite controller. The composite controller may be implemented in hardware with any or a combination of the following technologies, which are each well known in the art: a discrete logic circuit(s) having logic gates for implementing logic functions upon data signals, an application specific integrated circuit (ASIC) having appropriate combinational logic gates, a programmable gate array(s) (PGA), a field programmable gate array (FPGA), *etc.* The composite controller may transmit and receive data from the personal computer 12 and the printer 15.

The transparent scanning plate or platen 305, may take the form of a sheet of glass or other transparent material preferably resistant to scratches that may be caused by repetitively sliding source materials across a contact surface of the platen 305. For example, the platen 305 may be constructed of, but not limited to, plastic that will permit visible light to pass from the illumination source through the platen 305 to the source to be scanned 350 (*e.g.*, a photograph, a business card, a document, or other printed material). The platen material also permits the visible light to pass (*i.e.*, reflect) from the surface of the source 350 to be scanned through to the photosensitive detector associated with the scanning means. In order to maximize the range of sizes of source materials that may be scanned with the space-saving scanner assembly 100, a substantial portion of a source-contact surface formed by the exterior of the housing 300 will take the form of the platen 305.

As is also shown in the cross-sectional top view of FIG. 3, the housing 300 of the space-saving scanner assembly 100 may be configured with a source-support



channel 330. The source-support channel 330 may be arranged such that an edge of the source 350 to be scanned is closely arranged to coincide with the lower edge of the platen 305. It should be appreciated that this arrangement of the source-support channel 330 allows a substantial portion of the source 350 to be correctly positioned over the source-contact surface formed by the combination of the platen 305 and the exterior surface of the housing 300 such as to permit optical scanning. The source-support channel 330 may be configured from a material having a relatively low coefficient of friction to permit an edge of a source document, photograph, and other like materials to be scanned, to easily enter and exit the opening formed by the source-contact surface of the housing 300, the source-backing surface of the flap 310 (e.g., the pad 320) and the source-support channel 330.

As is further illustrated in FIG. 3, a portion of the source-support channel 330 may be configured to extend beyond both the housing 300 and the flap 310 of the space-saving scanner assembly 100 to form the lower surface of an opening suitable for receiving the source 350. It should be appreciated that the platen 305 and a pad 320 associated with the flap 310 will form the sides of the opening for receiving the source 350. It is significant to note that that portion of the source-support channel 330 that extends beyond the housing 300 and the flap 310 may be tapered such that the width of the source-support channel 330 decreases. This arrangement of the source-support channel 330 permits easy access to the substantially uniform portion of the support channel 330 that coincides with the platen 305.

The flap 310 may be associated with the housing 300 via a plurality of assemblies. As illustrated in FIG. 3, the flap 310 may be associated with the housing 300 via a pin 340. The pin 340 may be fixed to the platen side of the flap 310 and may be received within a recess (not shown) having one or more detent positions for keeping the internal or platen side of the flap 310 closely arranged with the source-contact surface of the housing 300 such that the source 350 is in contact with the platen 305. It will be appreciated that the pad 320 associated with the flap 310 may be constructed of foam or other compressible material capable of holding the source 350 in contact with the platen 305. The pad 320 may comprise a substantial portion of a source-backing surface that serves to protect both the platen 305 and the source 350 from adjacent

surfaces of the flap 310. In a preferred embodiment the flap 310 and the housing 300 are associated with at least two pins 340 and recesses with multiple detent positions.

As is further illustrated in the top view of FIG. 3, the flap 310 may be associated with the housing 300 using one or more adjusters 312. The adjusters 312 may comprise  
5 a thumb wheel fixed to a threaded shaft configured to match a threaded recess 315 provided in the housing 300. The combination of the adjusters 312 and the threaded recesses 315 permit an operator of the space-saving scanner assembly 100 to selectively adjust the compressive force applied from the pad 320 to the non-scan side of the source 350. This selective adjustment in combination with the aforementioned and described  
10 pins 340 and associated housing recesses permit an operator of the space-saving scanner assembly 100 to achieve the desired results from the optical scanning means contained within the housing 300.

While a combination of two adjusters 312 and two pins 340 is contemplated in a preferred embodiment, other arrangements of physical assemblies that permit an  
15 operator to selectively adjust the contact pressure applied to the source 350 when it is positioned over the platen 305 are contemplated and are considered within the scope of the space-saving scanner assembly 100. For example, a single pin 340 and its associated recess may be positioned near the center of the rear edge of the flap 310 and the housing 300. Alternatively, three or more pins 340 and their respective recesses may be spatially  
20 arranged along the rear edge of the flap 310 and the housing 300. These and other arrangements may be devised as addressed in the appended claims.

The various structures and assemblies of the space-saving scanner assembly 100 having been generally described with regard to FIG. 3, reference is now directed to FIG. 4, which presents a front view of the exemplary embodiment of the space-  
25 saving scanner assembly of FIG. 3. As illustrated in FIG. 4, the space-saving scanner assembly 100 may include a number of features generally associated with the front panel of the housing 300 and the flap 310 that may not be appreciated from the top view of FIG. 3. More specifically, the housing 300 may include the control interface 120 (see FIG. 2) and an inclined surface 417, whereas the flap 310 may include its own  
30 inclined surface 419.

As shown in the front view of FIG. 4, the interface panel 120 may have a

display 122 and several function selection switches 124. The display 122 may be used to indicate a present operational status of the space-saving scanner assembly 100. For example, the display 122 may provide information indicating whether DC power is available, an operating mode, the general health of components, and similar  
5 information. It should be appreciated that the display 122 may comprise an array of lamps, light emitting diodes (LEDs), liquid crystals, and other similar devices.

The function selection switches 124 may be used to permit an operator of the space-saving scanner assembly 100 to enter various information directly at the device in lieu of having to place a source 350 in the space-saving scanner assembly 100 and  
10 having to enter information at a peripheral device in communication with the personal computer 12 which may be inconveniently situated with regard to the space-saving scanner assembly 100. It should be appreciated that the plurality of function selection switches 124 may be used to select one or more printed document modes, such as but not limited to, "scan," "copy," "fax," "email," "optical character recognition (OCR)"  
15 *etc.* In addition, various function selection switches 124 may be provided to permit an operator to select a quantity of scanned source copies, or to vary one or more operator selectable parameters related to scanning image sources such as but not limited to photographs, maps, and the like. These may include function selection switches 124 configured to select a scan area, to scan for color content, to enhance the brightness of  
20 the illumination means, to apply various filters, to select a scan resolution, *etc.*

As also illustrated in the front view of FIG. 4, the inclined surfaces 417, 419 are arranged to permit the placing of the source 350 (*e.g.*, a single sheet of paper to be scanned) into the opening defined by the flap 310 and the housing 300 such that the source 350 is arranged to coincide with the platen 305 (FIG. 3). In order to prevent  
25 possible hang-ups or obstruction of the source 350 during an extraction from the space-saving scanner assembly 100, it is contemplated that the adjacent edge formed at the intersection of the housing 300 and the platen 305 be substantially at the same level to provide a smooth, and snag-free source opening. In this regard, the inclined surface 417 may extend into the source opening up to the front edge of the platen 305.  
30 In order to prevent similar hang-ups with regard to the flap 310, the inclined surface 419 may extend up to the front edge of the pad 320.

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As illustrated in FIG. 6, it may be necessary to insert a plug 319 into the opening 316 in order for the flap 310 to remain in close contact with the source 350 (see FIG. 3) and the platen 305. As shown in FIG. 6, the plug 319 may be configured such that it has an inclined surface that will coincide with the inclined surface 419 when the plug 319 is set within the opening 316. As further illustrated in FIG. 6, the plug 319 may be configured with a latch 322 configured to extend and closely contact a notch 318 in the flap 310.

While the opening 316 extends through the flap 310, the notch 318 and a related slot 313 are configured within the flap 310 such that the pad 320 remains continuous under the notch 318 and the slot 313. It will be appreciated that the surface of the plug 319 arranged to contact the back or non-scan side of the source 350 may be configured with its own pad similar to the pad 320. This arrangement provides the operator with the flexibility to use the space-saving scanner assembly 100 as a flatbed scanner in a flap up configuration, as well as, in a space-saving arrangement with the flap 310 and the housing 300 arranged in a side-by-side configuration suitable for a bookshelf or other limited space arrangements.

The flap 310 of the space-saving scanner assembly 100 having been generally described with regard to FIG. 6, reference is now directed to FIG. 7, which presents a schematic diagram highlighting alternative embodiments of the source-supporting channel 330 introduced the illustration of the housing 300 in FIG. 5. Two exemplary embodiments are shown. In a first embodiment, shown in the lower right portion of FIG. 7, the source-supporting channel 330 is illustrated in a partial perspective view. This embodiment reflects the source-supporting channel 330 previously introduced and described with regard to FIGs. 3 and 5. As previously described, the source-supporting channel 330 may extend past the front panel of the housing 300 and may be tapered such that a first end or source-receiving end closest to the front panel 300 may easily receive the lower edge of a source 350 to be scanned by the space-saving scanner assembly 100. As also previously described with regard to FIG. 5, the housing 300 may be configured with a recess 370 shaped to receive a significant portion of the source-supporting channel 330.

In preferred embodiments, the source-supporting channel 330 is configured

with a lip (not shown) disposed at an opposing end of the source-supporting channel (not shown). It will be appreciated that the lip may be arranged such that an insignificant portion (*i.e.*, a border) of the source 350 extends past the far edge of the platen 305 (see FIG. 3). In alternative implementations, the housing 300 may be  
5 configured with a plate (not shown) arranged to stop the source 350 from extending past the far edge of the platen 305. It will be appreciated that if a stop is added to the housing 300 that it may be necessary to provide a suitably arranged recess in the flap 310 to receive the plate when the flap 310 is adjusted to closely contact the platen 305 and the housing 300.

10 In a second embodiment, shown in the upper right portion of FIG. 7, the source-supporting channel 330' is illustrated in a second partial perspective view. This alternative embodiment shows that the source-supporting channel 330' may take the form of a U-shaped channel. As in the first embodiment, the source-supporting channel 330' extends past the leading edge of the platen 305 into an opening formed  
15 by the housing 300 and the flap 310 (not shown). It will be appreciated that other various structures may be used to implement the source-supporting channel 330'. For example, the source-supporting channel 330 may be implemented with a J-shaped trough (as viewed from the rear of the space-saving scanner assembly 100).

Regardless of the particular structural embodiment selected to implement the  
20 source-supporting channel 330, it is desirable to construct the source-supporting channel 330 with a material having a low coefficient of friction. It will be appreciated that a number of materials having a low coefficient of friction may be applied to the inner surfaces of the source-supporting channel 330. The low coefficient of friction on the inner surface of the source-supporting channel 330 will further ease operator  
25 placement and retrieval of source materials into and out from the space-saving scanner assembly 100.

Reference is now directed to FIG. 8, which illustrates alternative configurations of the platen 305 side (*i.e.*, the internal surface) of the flap 310. In a first alternative configuration illustrated in association with flap 310a, the underside of  
30 the flap 310a is configured with a spring-clip 810. As illustrated, the spring-clip 810 may be applied such that it extends over a significant portion of the lower edge of the

pad 320. The spring-clip 810 may be constructed of a material that provides enough resilient force to closely hold the source 350 to be scanned against the underside of the pad 320.

5 In a second alternative, illustrated in association with flap 310b, the underside of the flap 310b is configured with a plurality of clips 815. As shown, the plurality of clips 815 may be spatially arranged along the lower edge of the pad 320 so as to closely contact a range of various sized sources 350 to be scanned against the underside of the pad 320.

10 Alternative flap configurations having been introduced and described with regard to FIG. 8, reference is now directed to FIG. 9, which presents a top view of an exemplary embodiment of the space-saving scanner assembly 100 having a hinged flap assembly. As illustrated in FIG. 9, the space-saving scanner assembly 100 may be configured with an optional flap attachment means. As shown in the top view of FIG. 9, the optional flap attachment means may take the form of a hinge associated with the flap 15 310 and a plurality of posts configured to receive the hinge spatially arranged on the housing 300.

As shown in FIG. 10, the flap 310 may be substantially configured as previously described with a pad 320 fixedly attached to the side of the flap 310 that comes into contact with the platen 305. The flap 310 may have an inclined surface 419 to more easily permit an operator to introduce source 350 into an opening formed by the flap 20 310, the housing 300, and the source-supporting channel 330. This optional flap attachment arrangement permits an operator to introduce source 350 items that have a thickness greater than that, which can be supported by the source-supporting channel 330. For example, this arrangement may permit an operator to scan portions of a bound 25 book or other bulky items.

Reference is now directed to FIG. 10, which highlights an alternative embodiment suited for closely arranging the internal side of the flap 310 with the platen 305. As illustrated in FIG. 10, the space-saving scanner assembly 100 may include a number of features generally associated with the front panel of the housing 30 300 and the flap 310 for closely arranging the flap 310 with the housing 300 when a source 350 has been positioned over the platen 305 in preparation for scanning the

source 350. More specifically, the housing 300 may include one or more posts 1012 (one shown with the housing 300) associated with a clasping member 1010.

As shown in FIG. 10, the clasping member 1010 is configured such that it closely contacts an associated pin 1020 (one shown with the housing 300, a second shown associated with the flap 310). A spatial arrangement of posts 1012, the clasping members 1010, and the pins 1020 may be predetermined such that when the clasping members 1010 are positioned to closely contact the pins 1020, the pad 320 on the internal surface of the flap 310 comes in close contact with the platen 305. It should be appreciated that a number of known assemblies will suffice and are readily commercially available that may also serve to close the source opening between the flap 310 and the housing 300. For example, these assemblies may include an elastic fabric provided with hooks that may be brought in close contact with a corresponding fabric having a plurality of small loops. These assemblies may also include various snap fasteners associated with an elastic fabric and or a variety of adjustable force latches. These and other assemblies for adjustably closing the opening between the flap 310 and the housing 300 are deemed within the scope of the space-saving scanner assembly 100.

It should be emphasized that the above-described embodiments of the space-saving scanner assembly 100, particularly, any "preferred" embodiments, are merely possible examples of implementations, merely set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiment(s) of the invention without departing substantially from the spirit and principles of the invention. All such modifications and variations are intended to be included herein within the scope of this disclosure and the space-saving scanner assembly 100 as protected and set forth by the following claims.